Sustainable Communities

Environmental Design Ideas for the Army

William Becker

U.S. Department of Energy

Worldwide Environmental & Energy Conference 2000

Topics

- What is sustainable development?
- Best practices by U.S. communities
- Tools you can use
- Ideas for Army “communities”

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- What is sustainable development?
- Best practices by U.S. communities
- Tools you can use
- Ideas for Army “communities”

DENVER AND THE WEST

DPO DenverPost.com denverpost.com/news

March 17, 2000 SECTION B THE DENVER POST

Growth, sprawl top area's concerns

Crime, drugs a distant 2nd

Mock Denver Post Article with actual

Denver area residents enter the new century happy with their community in many ways, but deeply worried by the problems of growth, sprawl and traffic that overwhelm all other concerns. An astonishing 60 percent of Denver residents cite this complex of problems as the top local issue.

This level of concern easily tops any of those found in the other Pew Center for Civic Journalism (PCCJ) surveys and moves substantially beyond the levels found in many other surveys on the most important issue at either the local or national level.

Residents are concerned that local officials are not paying enough attention to the problems of sprawl and growth, even as the public is itself divided about how to deal with the complexities of the issues.

Given the huge level of concern about growth and sprawl, no other issue can come close - among any group of residents. Crime, violence and drugs are the major local problem mentioned by nine percent of Denver residents. Six percent mentioned educational issues as the major local problem.

In response both to the open-ended questions and to the more specific queries about education, race and lifestyle, there are often differences by various demographic groups - particularly in the opinions of the seriousness of problems that face the community and in the judgments of the institutions charged with solving those problems.

- White residents and minority residents have sharply different views on whether local institutions treat minorities fairly. For example, three in five white residents say the police treat everyone equally, while only about one in five minority residents agree.
- Residents are more likely to say that recent immigrants from other countries caused problems in the United States than they are to say that the immigrants have made contributions. Thirty-nine

Please see **SPRAWL** on 6B

Images from Subdivide and Conquer, Inc

An astonishing 60 percent of Denver residents cite growth, sprawl and traffic as the top local issue.

"What's the use of running fast if you're not on the right road?" - Old German Proverb

"Within the neighborhoods, the towns, the local communities of America are the stirrings of a new movement of citizens acting together to solve community problems."

- National Commission on Civic Renewal

Community Code Words

- Smart Growth
- Livability
- Sustainable Development

New Way of Thinking…

"The world we have created today as a result of our thinking thus far has problems which cannot be solved by thinking the way we thought when we created them."

Albert Einstein

What is Sustainability?

"Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs."

- United Nations World Commission on the Environment (1987)

Systems Thinking

- Economy
- Environment
- Quality of Life

Role of Technology

- Industrial Era:

$$I = P \times A \times T$$

- Sustainable Era:

$$I = \frac{P \times A}{T}$$

Sustainability's benefits...

- Creates Jobs
- Saves Money
- Improves the Environment
- Improves Quality of Life
- Gives Communities a Future

Topics

- What is sustainable development?
- Best practices by U.S. communities
  - Buildings, real estate, land use, transportation, industry, energy production
- Tools you can use
- Ideas for Army “communities”

Sustainability in Buildings

More affordable housing, more productive businesses, less pollution

DOE Goal: "Whole-Building Design"

- Million Solar Roofs: 1 million units by 2010, 70,000 high-tech jobs
- Energy $mart Schools: Save $1.5 billion/year
- Rebuild America: Save 100 trillion BTUs, 1.6 million tons CO2
- PATH: Cut energy use 50% in new homes, 30% in existing homes
- Federal Energy Management Program: Cut energy use 30% by 2005 in 500,000 buildings

Green Builder Program

Austin's Green Builder Program and American Youth Works employ at-risk youth to build energy efficient homes

Green Builder Program

- Certifies homes (1-4 stars)
- Voluntary
- Technical assistance for builders
- Education for home buyers

Green Builder Program

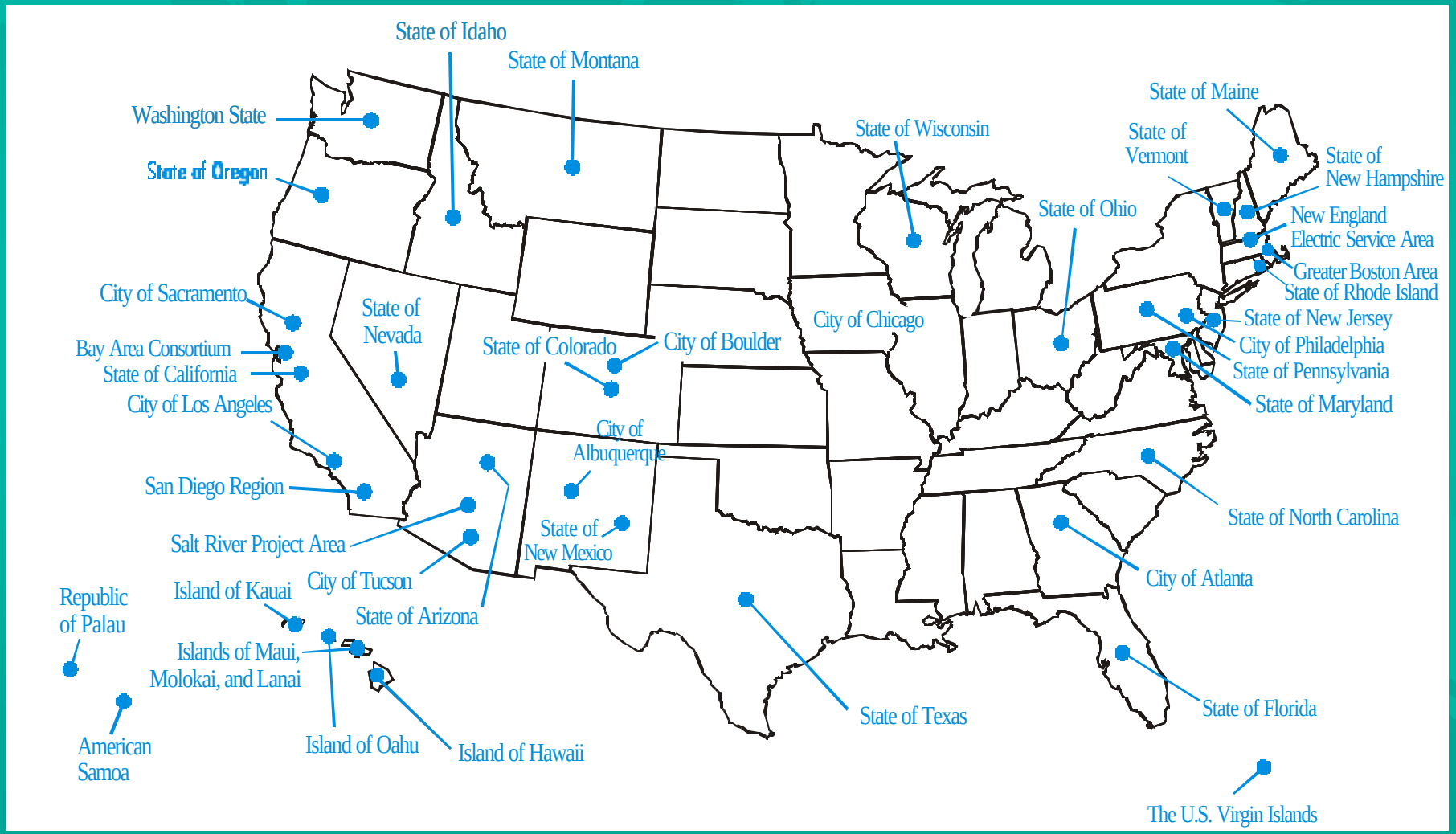
Areas of Emphasis

- Energy Efficiency
- Water Conservation
- Materials Efficiency
- Waste Handling

Building-Integrated Solar

- Brownouts, quality concerns cause interest in “distributed generation”
- Grid-connected homes: PV can run meter backwards
- Remote homes: for sites more than 1/4 mile off of utility grid, PV is generally cost-effective.

Million Solar Roofs: Partnerships



Utah's DNR Building

* Light shelves - Daylighting
* Reclaimed materials
* Evaporative cooling
* High performance motors
* On-demand lighting
* Open offices

Productivity Factor

- Salaries $130
- Rent $ 21
- Total Energy $ 2
- Energy Saving Potential - Good
- Productivity Potential - Exceptional

(Costs per square foot of typical office building. Source: Building Owners and Managers Association)

Utah's Savings

- Energy use cut 43% from code reference case
- Energy cost savings = $50,000 per year
- Capital Cost = $300,000 ($10 m total)
- Simple Payback: 6 years
- Estimated 30-year savings: $18 million (including productivity)

Four Times Square

New York City

- Green building materials
- Water-conserving plumbing systems
- Recycling chutes
- CO_2 monitoring and ventilation control
- Daylighting/energy-efficient lighting
- Building-integrated photovoltaics
- Fuel cells
- Energy costs reduced 50% over buildings built in 1980s

Next Step: Concentric Design

Built environment affects...

- Social equity
- Disposable income
- Air quality
- Public health
- Local aesthetics
- Tax base
- Infrastructure costs
- Need for cars
- Open space
- Solar access
- Scenic views
- Worker productivity

Concentric Design

- Individual building
- Microclimate
- Neighborhood
- Community
- Region

Sustainability in Real-Estate Development

Redefining Good Development

Making Livable Communities

Ahwahnee Principles

- **Complete & integrated communities**

Market Benefits

- Homes sell at 11%/Sq. Ft. premium (Village Homes)
- Buyers will pay $40,000 more for open space (American Lives)

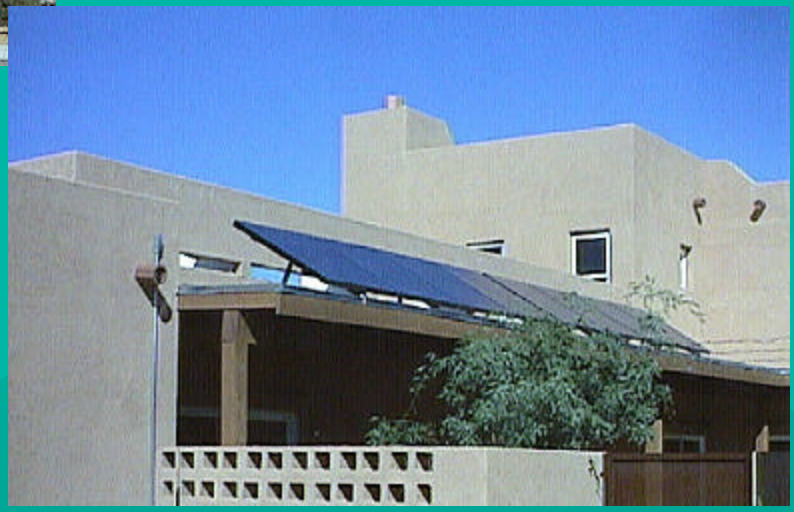
Tamarack Point
Steamboat Springs, CO.

- 29 homes
- 1,140-1,500 sq.ft.
- $128 -180,000
- Narrow streets
- Smaller front & bigger back yards

Tamarack Point

- Solar orientatio
- R-27 walls
- R-50 ceiling
- Low-E window
- Low-flow fixtures

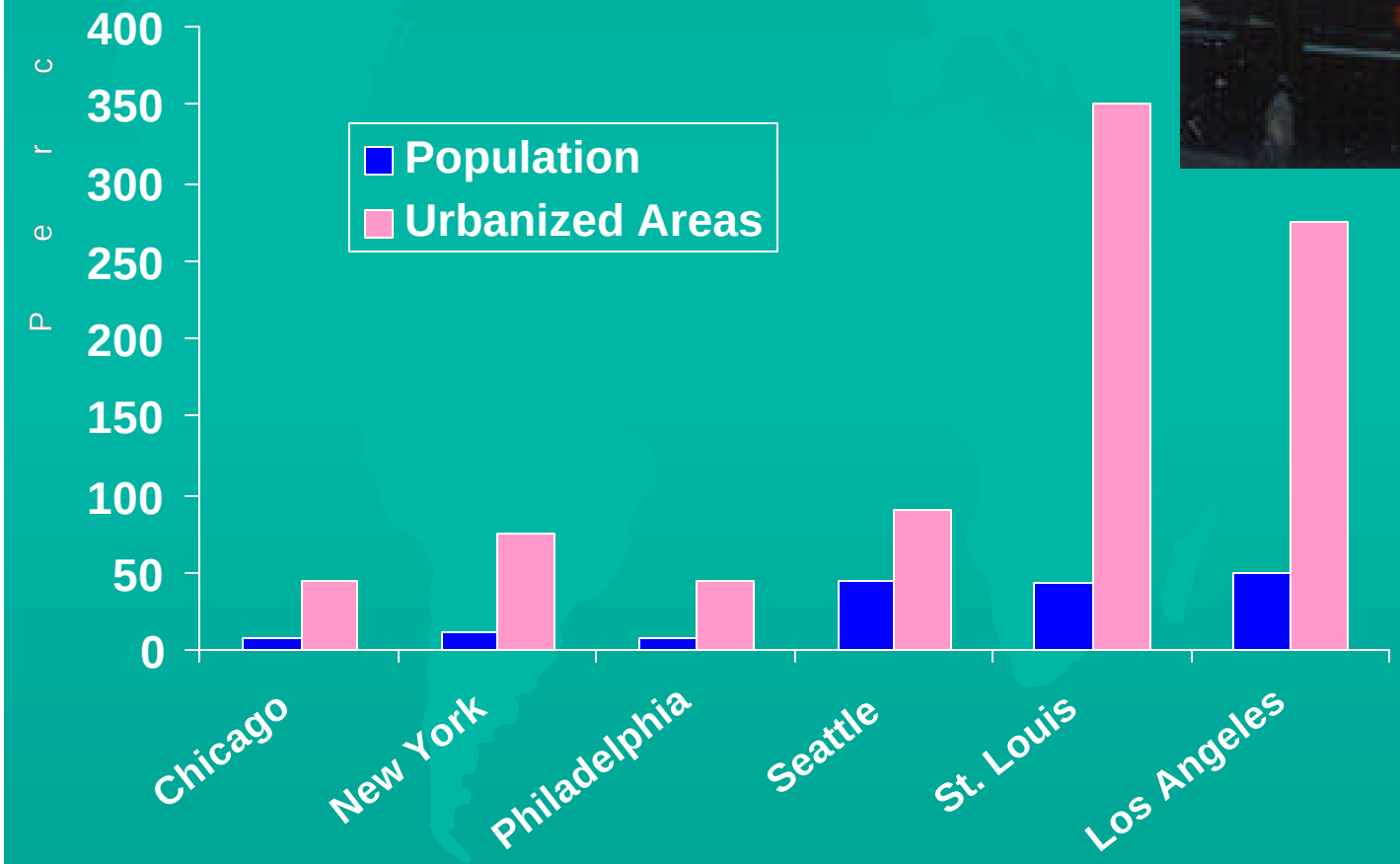
Civano



Sustainability in Land-Use Planning

Combatting Sprawl with Smart Planning

Combatting Sprawl
1970-1990



Note: St. Louis data show 1950-1990
Source: Henry Diamond and Patrick Noonan, *Land Use in America*, 1996

Costs of Sprawl

- Every new classroom costs $90,000
- Every mile of new sewer line costs $200,000
- Every mile of new single-lane road costs $4 million

-- Maryland Gov. Parris Glendening

U.S. Government Anti-Sprawl Initiatives

- EPA Smart Growth program: Provides technical assistance to communities
- EPA Brownfields program: Encourages infill development on industrial sites
- White House Livability Task Force: Promotes Regional Partnerships & Resource Centers

Portland's Land-Use Leadership

- Urban growth boundary
- Metro government
- Cap on parking spaces
- Mandatory trip-reduction plans by business
- Highway relocated from downtown
- Increased housing density & mixed use

Portland's Land-Use Leadership

- 10-year property tax break for housing near mass transit
- 30 miles of light rail
- Downtown bus mall
- Free shuttle buses downtown
- Downtown brownfields redevelopment

Living with Nature

Soldiers Grove escaped floods and built a solar town

Sustainability in Transportation

Improving Community Health, Mobility and Efficiency

Transportation today

- Urban congestion
- Air & greenhouse gas emissions
  - * 78% CO2
  - * 37% VOCs
  - * 45% NOX
  - * 15,000 deaths/year
- Foreign oil dependence – 50-60%
- Foreign trade deficit - $50 billion +

Federal Transportation Efforts

- Alternative Fuel Vehicles
  - Energy Policy Act AFVs
  - 70 “Clean Cities”
  - Incentives in 30 States

- Partnership for a New Generation of Vehicles
  - Collaboration between U.S. government & Big 3 car makers
  - 80 MPG car
  - Same cost, comfort, convenience

Reducing Emissions

Enhancing Mobility

Chattanooga's electric buses; Portland's light rail

Enhancing Mobility

Chattanooga's 35-mile trail system gives residents safe and pleasant alternatives to motor vehicle travel.

Industrial Ecology

Industries as systems, wastes as resources

Making Waste Obsolete

- Zero defects (“Quality is Job 1”)
- Zero accidents (“Safety First”)
- Zero inventory (“Just-in-Time Delivery”)
- Zero wastes

Interface Carpets' Evergreen Lease

Promises:

- Uses recyclable materials
- Reduces fiber content
- Practices "Extended product responsibility"
  - Leases tiles
  - Recovers & recycles worn tiles
- Pledge: No landfill wastes

Results:

- 22.5% more resource efficiency
- $40 million/year waste reduction
- 80% less landfill from production wastes
- Profits, share prices rise

Eco-Industrial Parks

- Each industry maximizes pollution prevention & waste minimization
- Each industry's "wastes" used as resource by neighboring industries
- Goal: No net wastes generated by industrial park

Industrial Engineering

Burlington, Vermont

Sustainability in Energy Production

Reducing greenhouse gas emissions, air pollution & threats to public health

Emerging Trends in U.S.

- Declining renewable energy prices
- Growing conventional energy costs
- Greater consumer choice
- “Green” pricing

Photovoltaics: Use Up, Cost Down

1980: $1.00/kWh

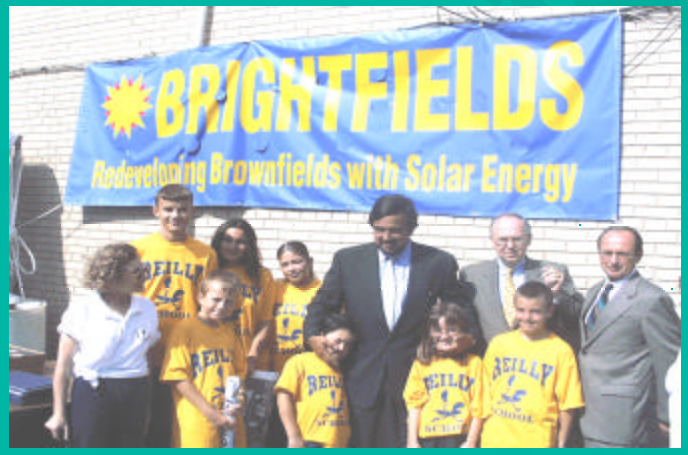
2000: ~$0.20 cents/kWh

2005: ~$0.10 cents/kWh

- **Sacramento Municipal Utility District's (SMUD) 2-MW plant (2 acres)**
- **Enough power for 660 Sacramento-area homes**
- **Replaces some nuclear-generated power**

Brightfields

- Redevelop brownfields with solar manufacturing plants
- Chicago first
  - Announced August ‘99
  - City & Utility pledge $8 million in PV purchases
  - Spire Corp. builds 100-employee plant



Cost of Wind Electricity

1979: 40 cents/kWh

2000:
4-6 cents/kWh

2003:
2.5-4.5 cents/kWh

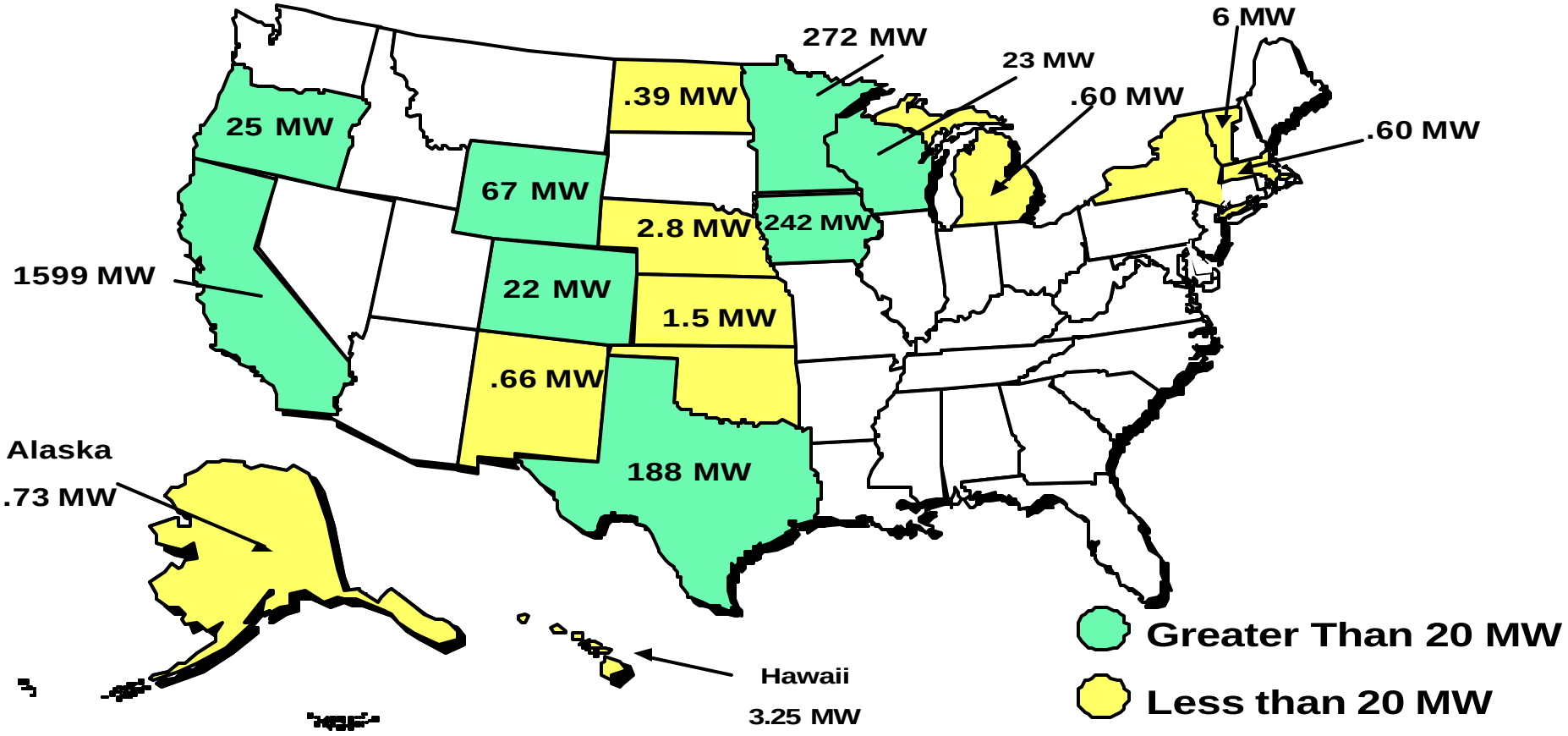
- Increased Turbine Size
- R&D Advances
- Manufacturing Improvements

NSP 107 MW Lake Benton wind farm
4 cents/kWh (unsubsidized)

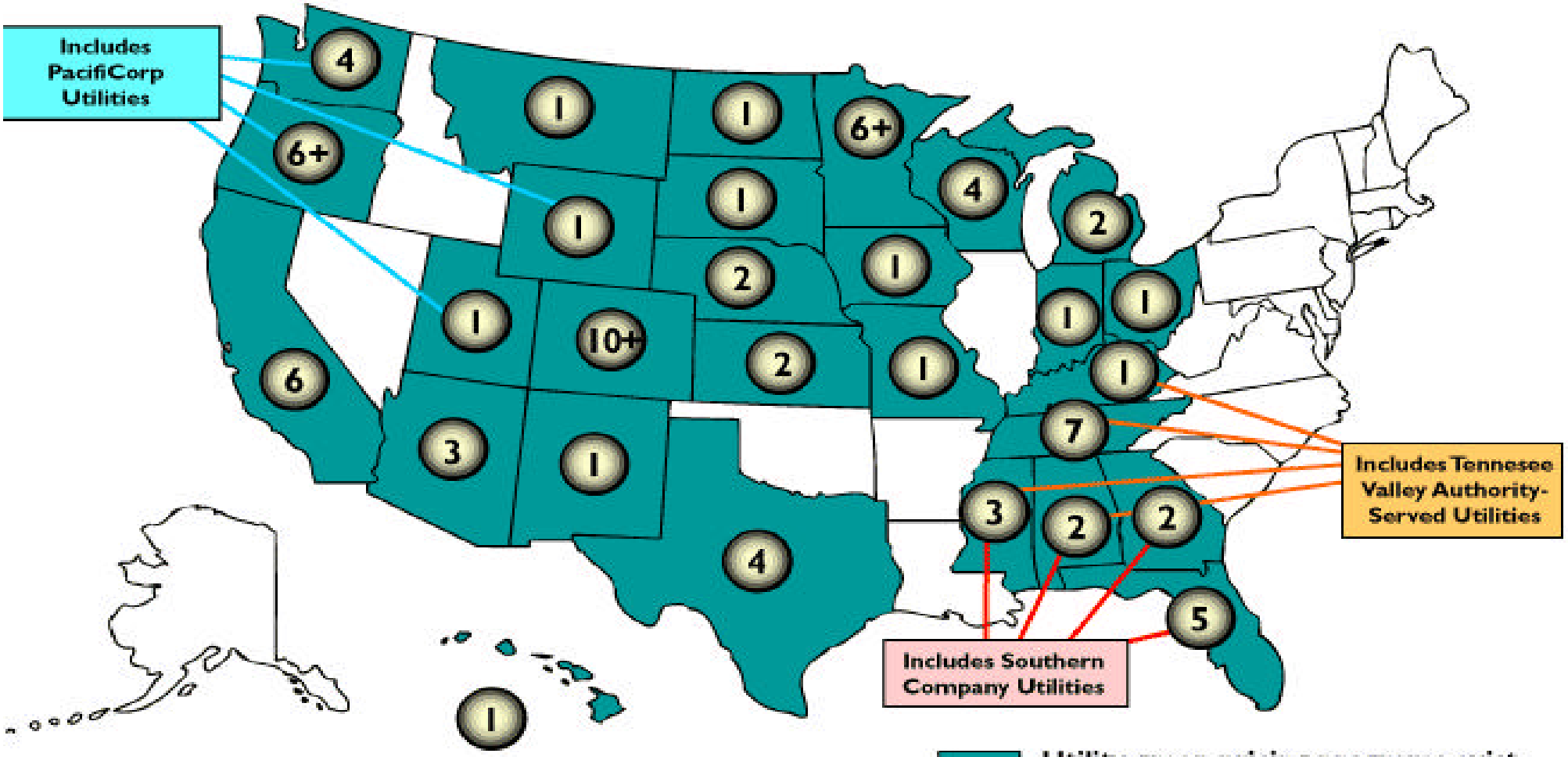
United States Wind Power Capacity On-Line

2455 MW as of 12/31/99

Updated 1/11/00

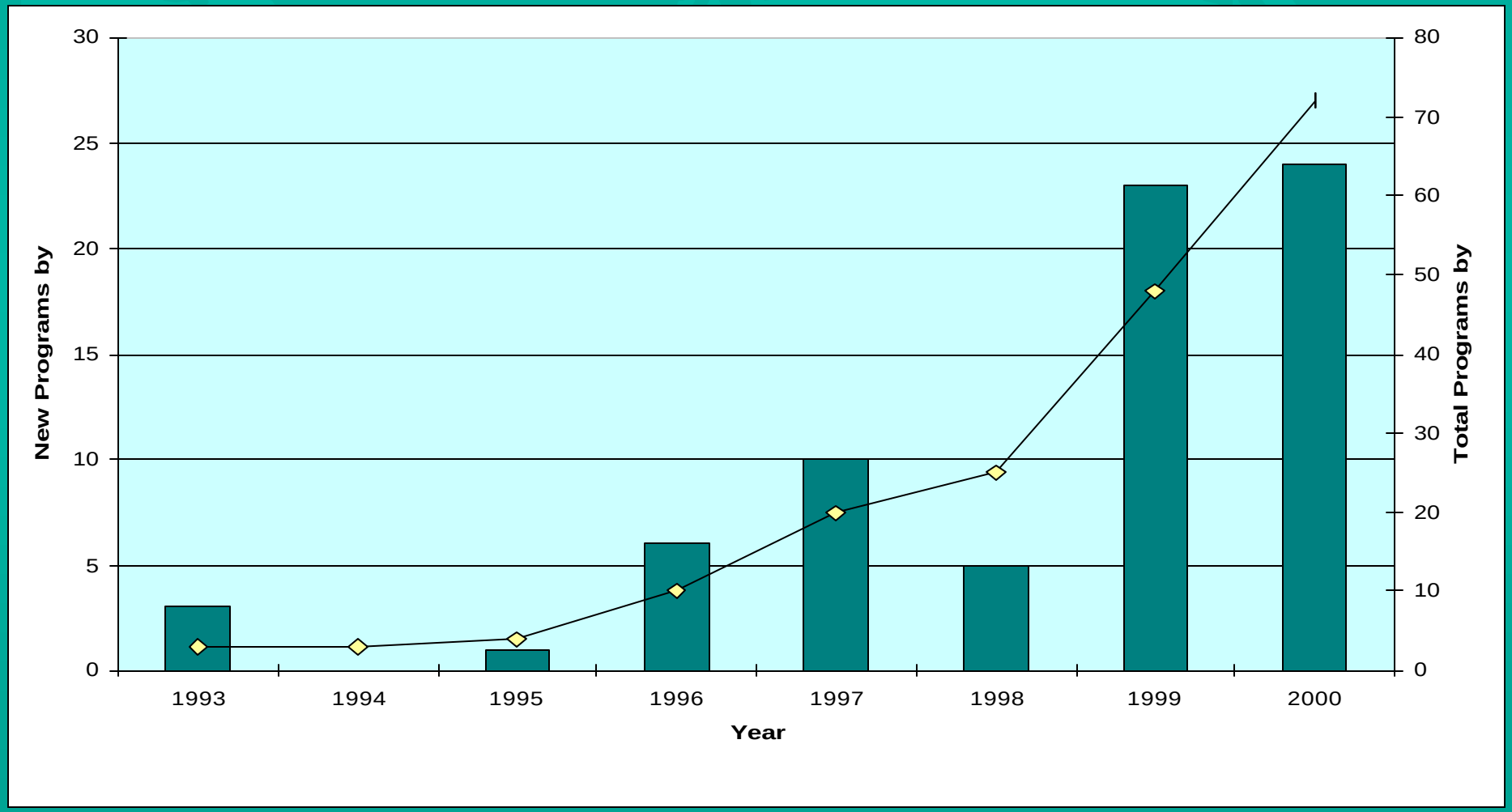


Utility Green Pricing Activities



Source: National Renewable Energy Laboratory, June 2000

Number of Green Pricing Programs (1993 to Date)



WindSource in Colorado

- Consumers buy wind power at $2.50 per 100 KWhr block
- $12.50 per month = 100% green power
- Wind farm serving 1.1 million customers

Topics

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- Best practices by U.S. communities
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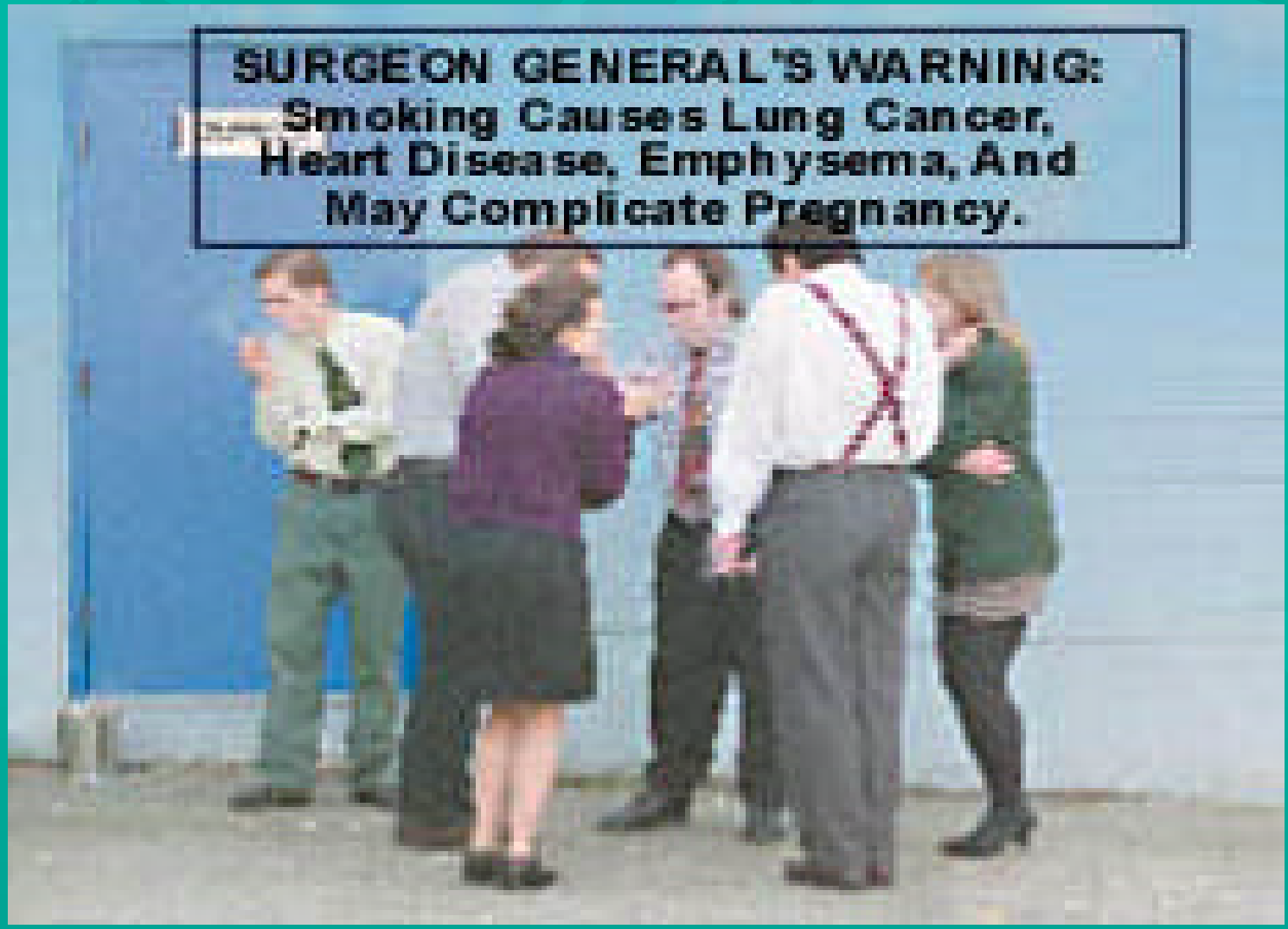
Information is Key

“Armed with good information and the tools to apply it, most people will make good decisions.”

-- Bill Becker, US Dept of Energy

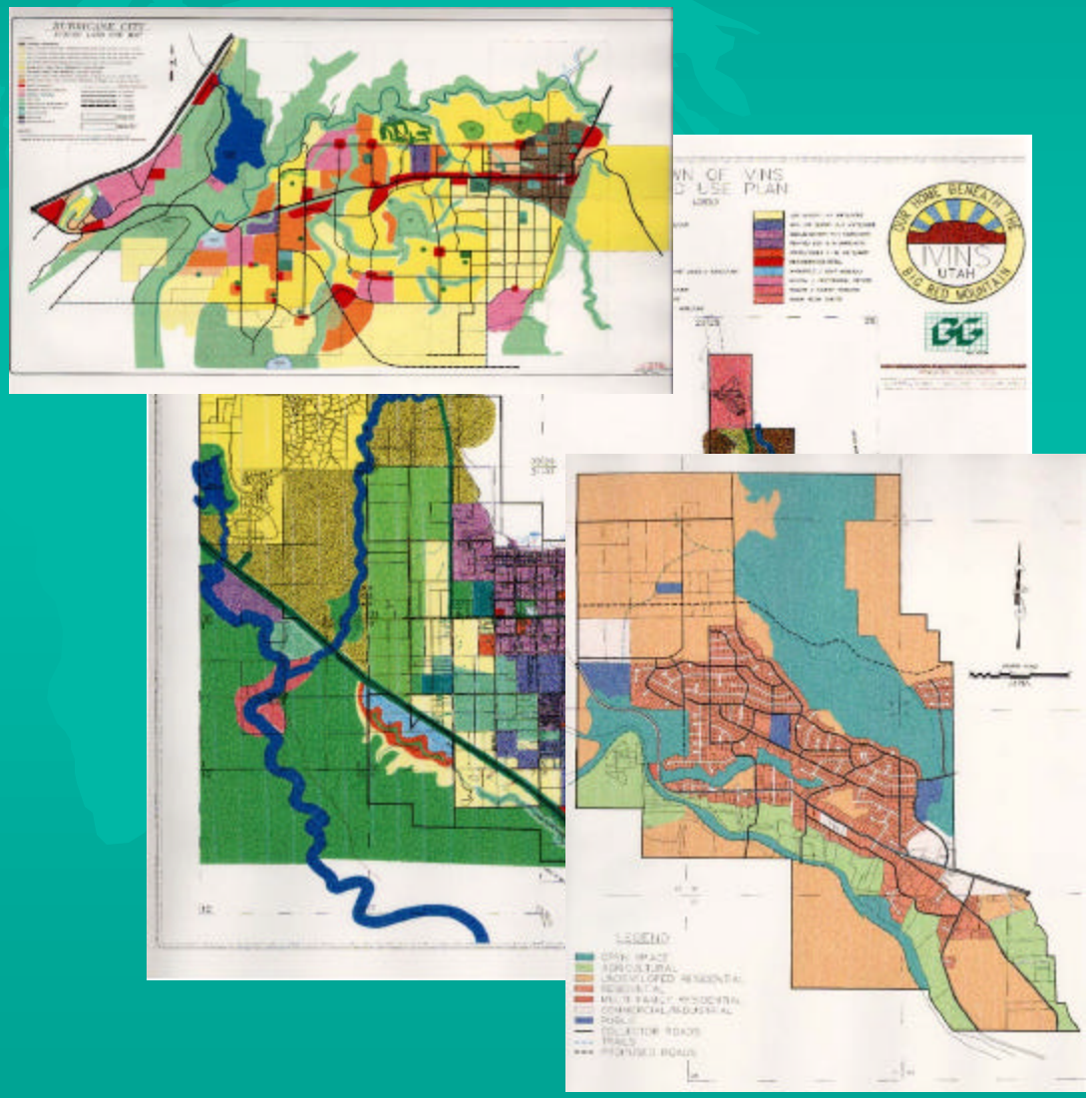
Okay, so not always…



Community Planning Today

The cumulative, unintended consequences of independent decisions

- Incompatible land uses adjacent across city boundaries.
- Road/greenway systems don't interconnect gracefully.



Technology Changing How We Make Decisions

- Technology changed way doctors treat patients
- Technology helps planners build better communities

age: Peter Katz

Uninformed Planning

Place-Based Planning

Decision Support Tools

- Information Resources
- Visualization Tools
- Impact Analysis
- GIS Modeling
- Community Process Tools

DOE Website
www.sustainable.

United States Department of Energy Office of Energy Efficiency and Renewable Energy

Center of Excellence for Sustainable Development Website

United States Environmental Protection Agency

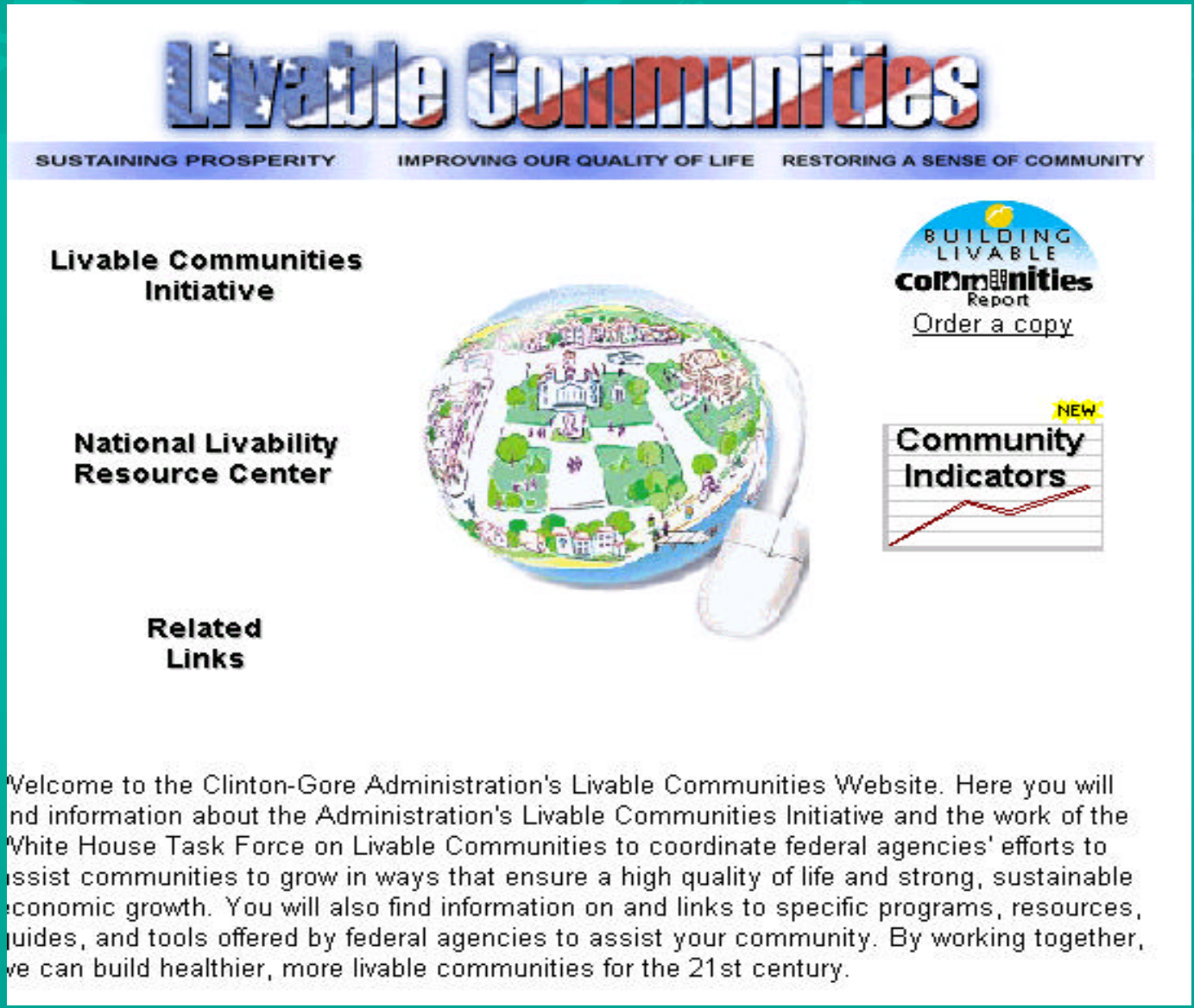
EPA's Transportation Air Quality Center

New Tools for Community Design and Decision Making: An Overview

Based on a presentation by Peter Katz that was funded by the John D. and Catherine T. MacArthur Foundation

This presentation is about the planning tools of the next century. New Urbanism and Smart Growth concepts have been widely embraced for redevelopment and new growth areas. Yet the problems faced by

Community Indicators



Community Indicators

- *Air & Water Quality*
- *Arts & Recreation*
- *Community Involvement*
- *Consumption*
- *Contamination & Haz. Mat'ls*
- *Economic Prosperity*
- *Ecosystem Integrity*
- *Education*
- *Employment*
- *Equity*
- *Family Structure*
- *Fiscal Responsibility*

- Global Climate Change
- Government
- Housing
- Human Health
- Population
- Public Safety
- Scientific & Technological Advancement
- Status of Natural Resources
- Stratospheric Ozone Depletion
- Transportation

Decision Support Tools

- Information Resources
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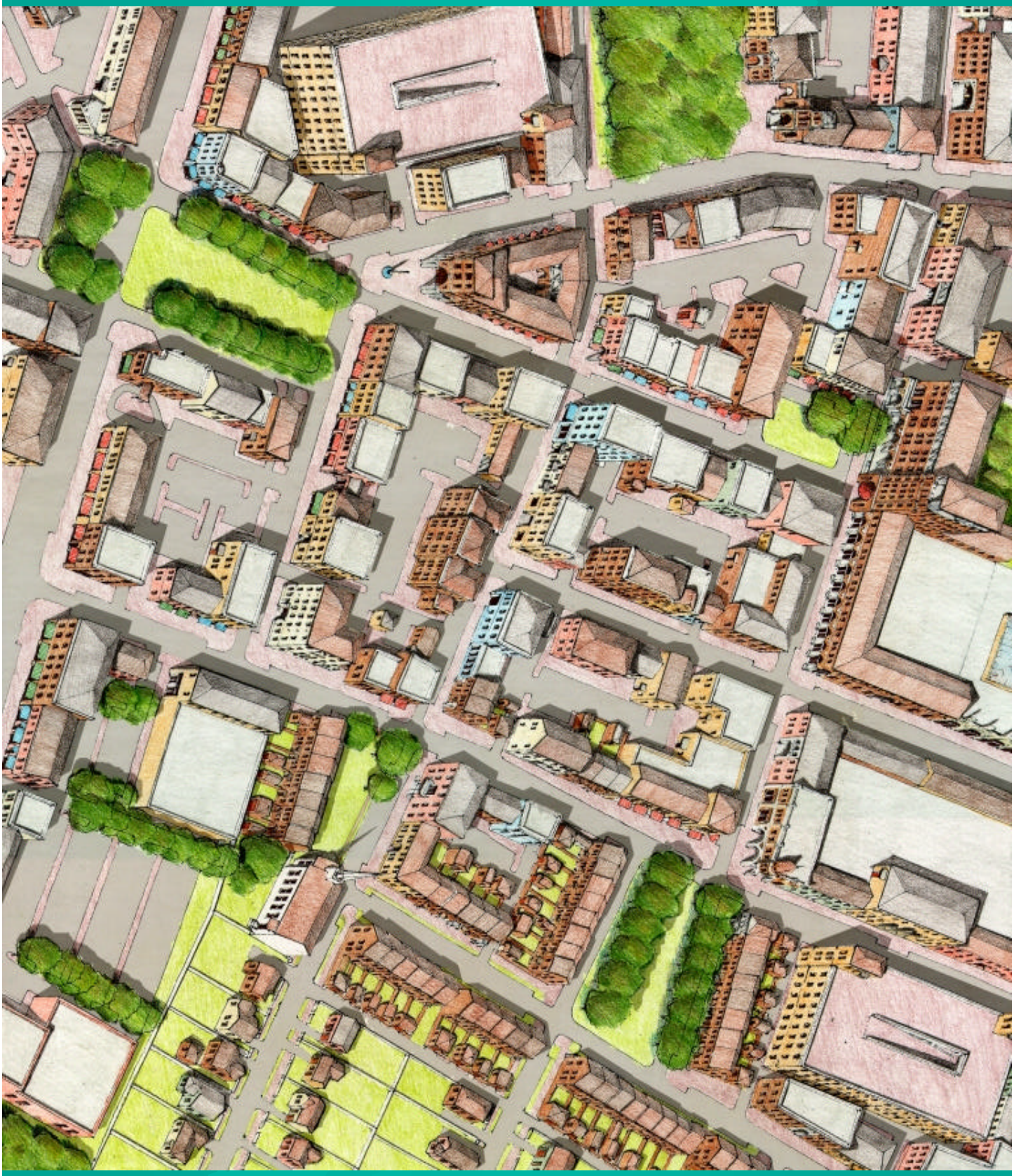
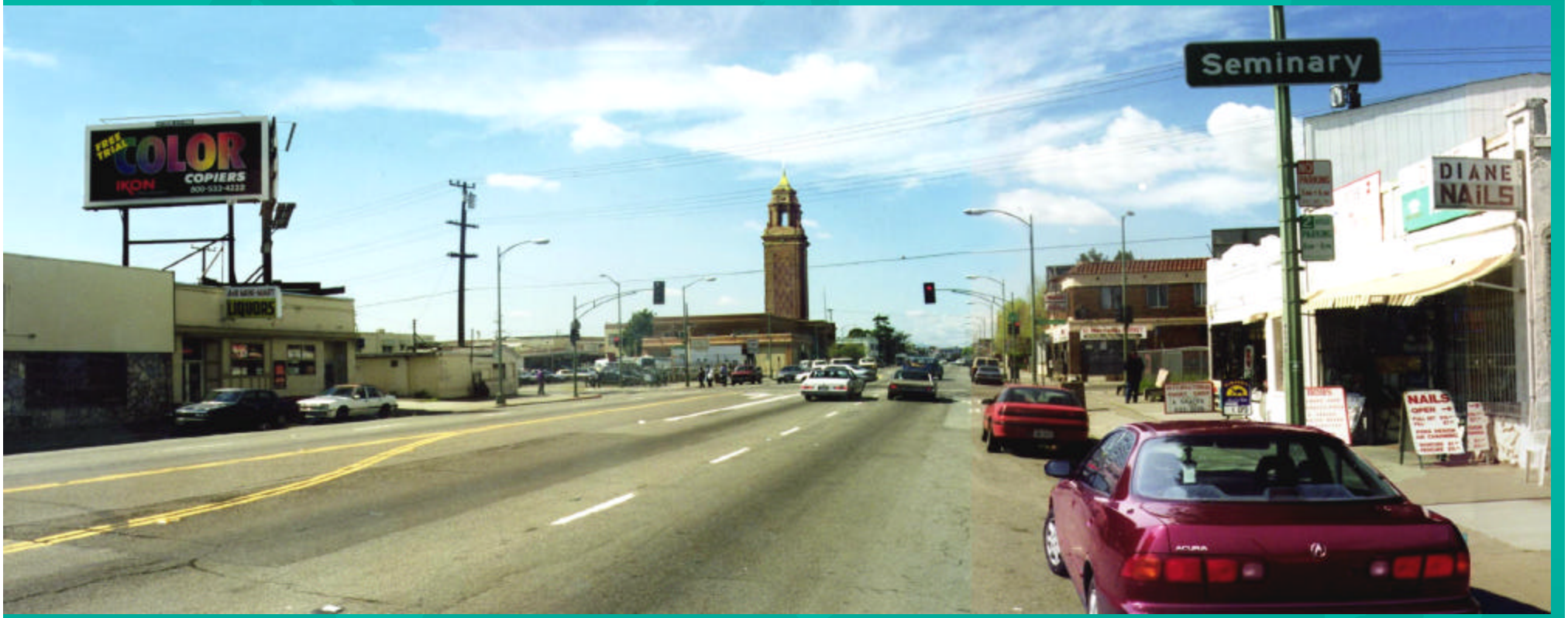
Dover & Kohl - Miami

Dover & Kohl - Miami



Steve Price
Urban Advantage



Steve Price
Urban Advantage

Dover & Kohl - Miami

)over & Kohl - Miami

Jim Constantine/LRK

Hillsborough Survey - [Streetscape Elements (composite)]

Streetscape Elements

I like the existing conditions.

Buried utility wires and street trees

Decorative streetlights and signage

Main Street buildings and sidewalk cafes

Please select any streetscape element(s) you would like to see improved along Route 206.

Continue

Jim Constantine/LRK

Hillsborough Survey - [Streetscape Elements (composite)]

Streetscape Elements

I like the existing conditions.

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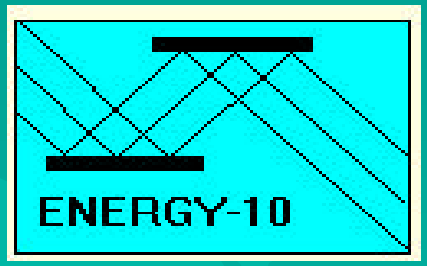
Continue

Decision Support Tools

- Information Resources
- Visualization Tools
- Impact Analysis
- GIS Modeling
- Community Process Tools

Energy-10



Reference Case Defaults

Building Use : Grocery

Constructions :

Wall:	steelstud 4
Roof:	flat, r-19
Window:	4060 double, alum
Floor:	slab
Floor Type:	Slab on Grade

Floor-to-Floor Height (ft):	15.00
Wall Glazing Fraction:	0.15
Workdays per week:	6
Additional Non-workdays per year:	8

Internal Load Peaks:

	Peaks: Typical Work Day	Peaks: Autosize
Int Lights, W/ft²	1.16	1.16
Ext Lights, W/ft²	0.26	0.26
People, ft²/person	50.00	50.00
Hot Water, W/ft²	0.16	0.16
Other loads, W/ft²	3.84	3.84

HVAC Controls :

Schedule : 8-to-8

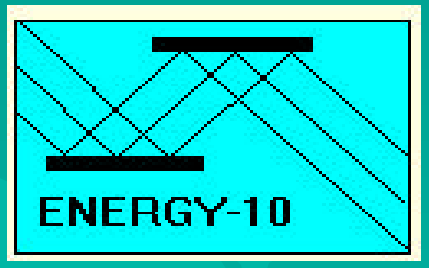
Cooling Setpoint :	74.0	°F
Heating Setpoint :	72.0	°F

Close

Modify

Help

Energy-10



Energy Efficient Strategies to Apply

Please select the Energy Efficient Strategies to apply:

- [x] Daylighting
- [x] Glazing
- [x] Shading
- [x] Energy Efficient Lights
- [ ] Photovoltaics
- [x] Insulation
- [x] Air Leakage Control
- [ ] Thermal Mass
- [ ] Passive Solar Heating
- [ ] Natural Ventilation
- [x] Economizer Cycle
- [ ] Exhaust Air Heat Recovery
- [x] High Efficiency HVAC
- [x] HVAC Controls
- [x] Duct Leakage
- [ ] Solar Air Preheat
- [ ] Solar Water Heating
- [ ] Evaporative Cooling

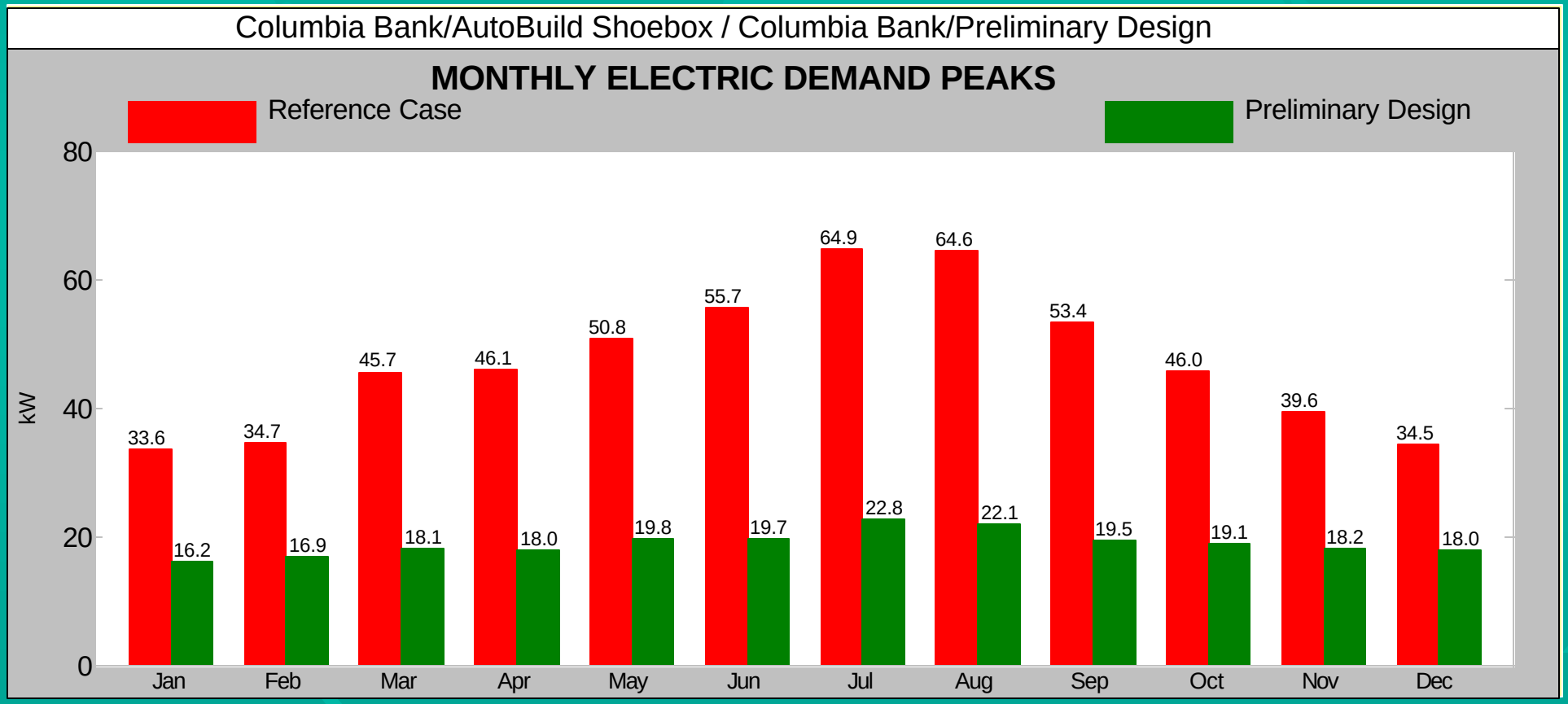
Apply | Cancel | Unapply | Help

Apply modifies building 2

Start with: (•) Building 1 ( ) Building 2

Save As Default

Energy-10


Columbia Bank/AutoBuild Shoebox / Columbia Bank/Preliminary Design
MONTHLY ELECTRIC DEMAND PEAKS
Reference Case
Preliminary Design
kW
0
20
40
60
80
33.6
16.2
34.7
16.9
45.7
18.1
46.1
18.0
50.8
19.8
55.7
19.7
64.9
22.8
64.6
22.1
53.4
19.5
46.0
19.1
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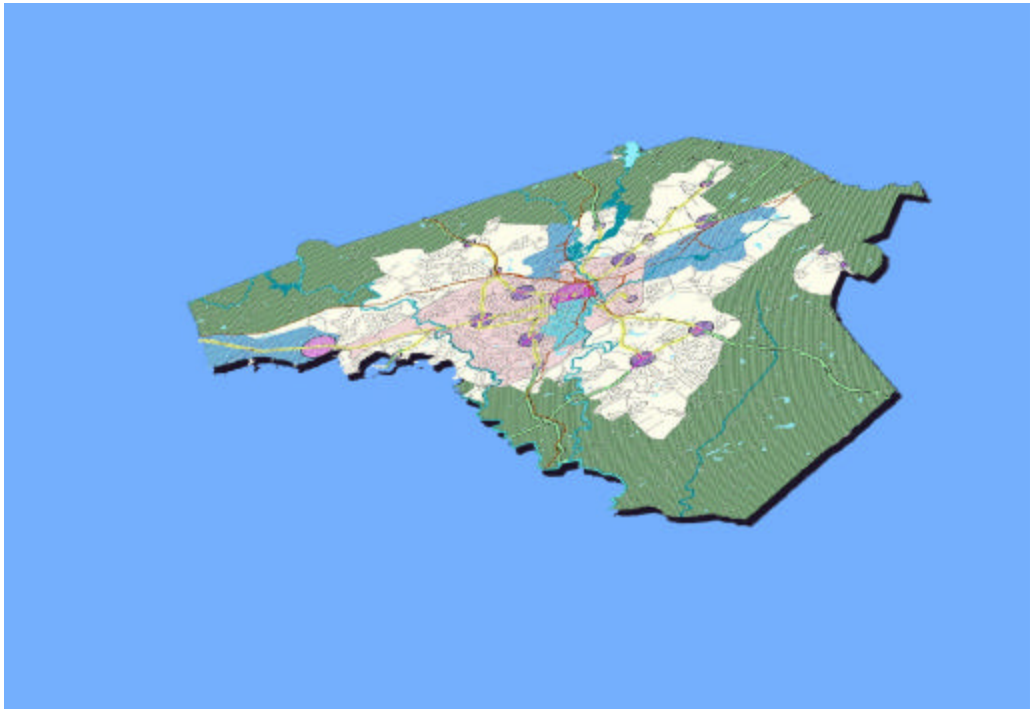
Decision Support Tools

- Information Resources
- Visualization Tools
- Impact Analysis
- GIS Modeling
- Community Process Tools

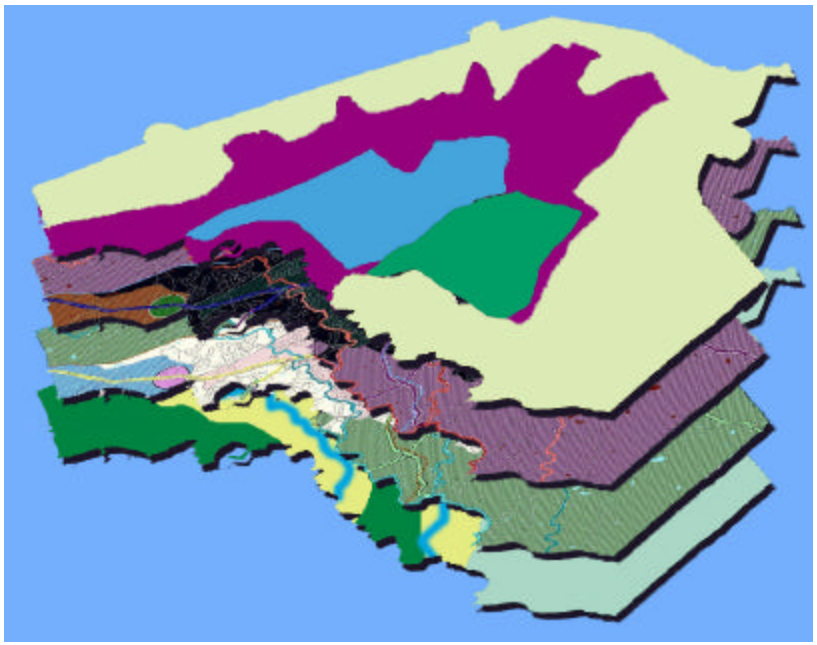
Geographical Information Systems

Integration Across Scale



Geographical Information Systems

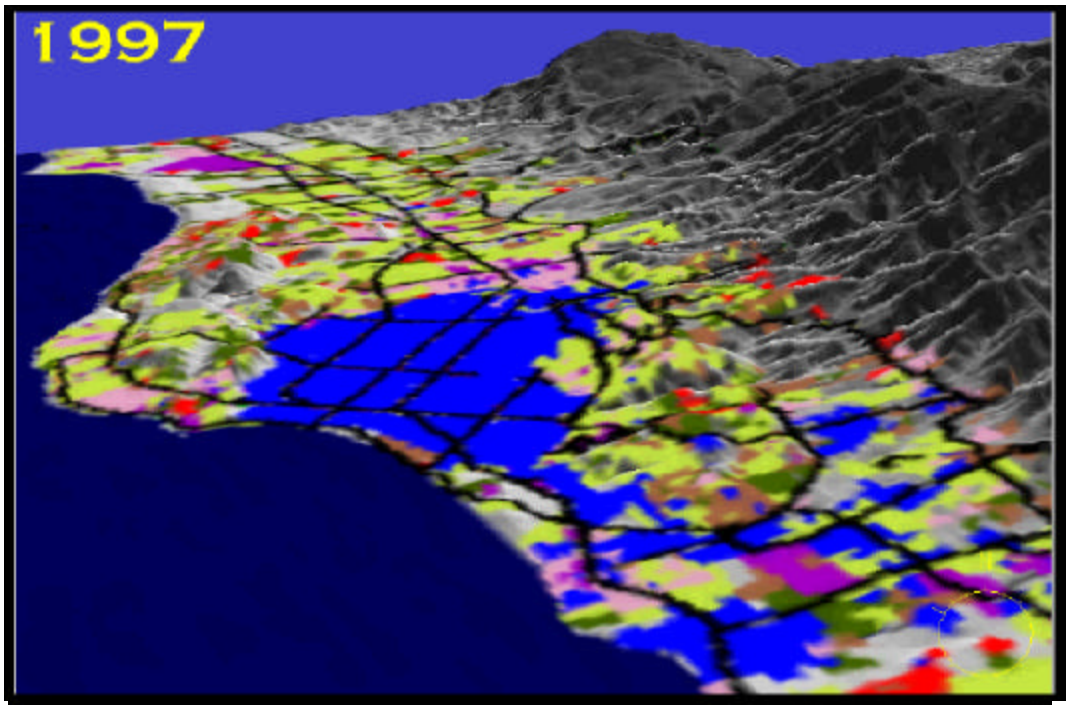
Integration Across Disciplines



- Social
- Economic
- Built
- Natural

Geographical Information Systems

Integration Across Time

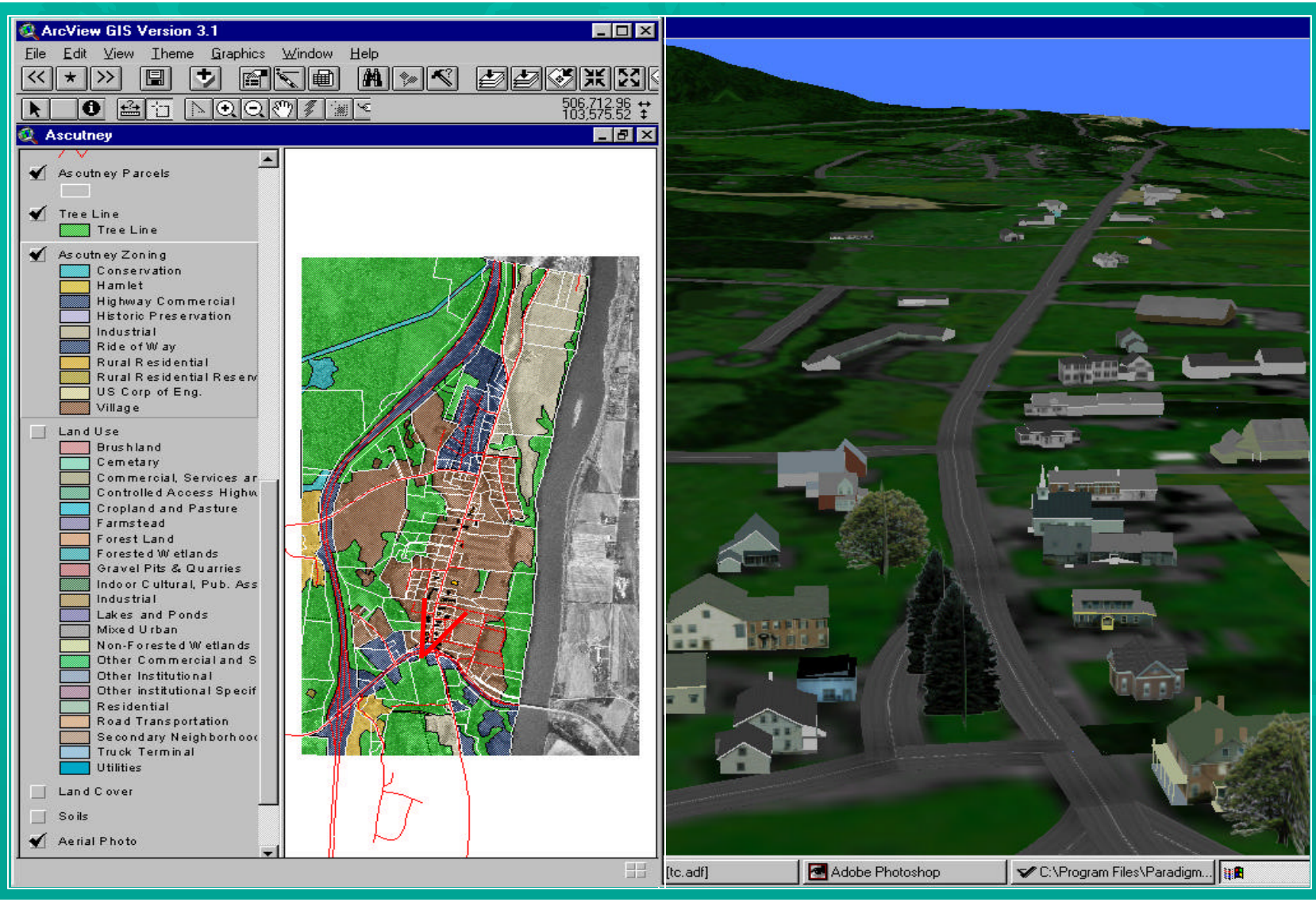


Temporal Sequence 1929-1997

data - UCSB / Dr. Keith Clarke

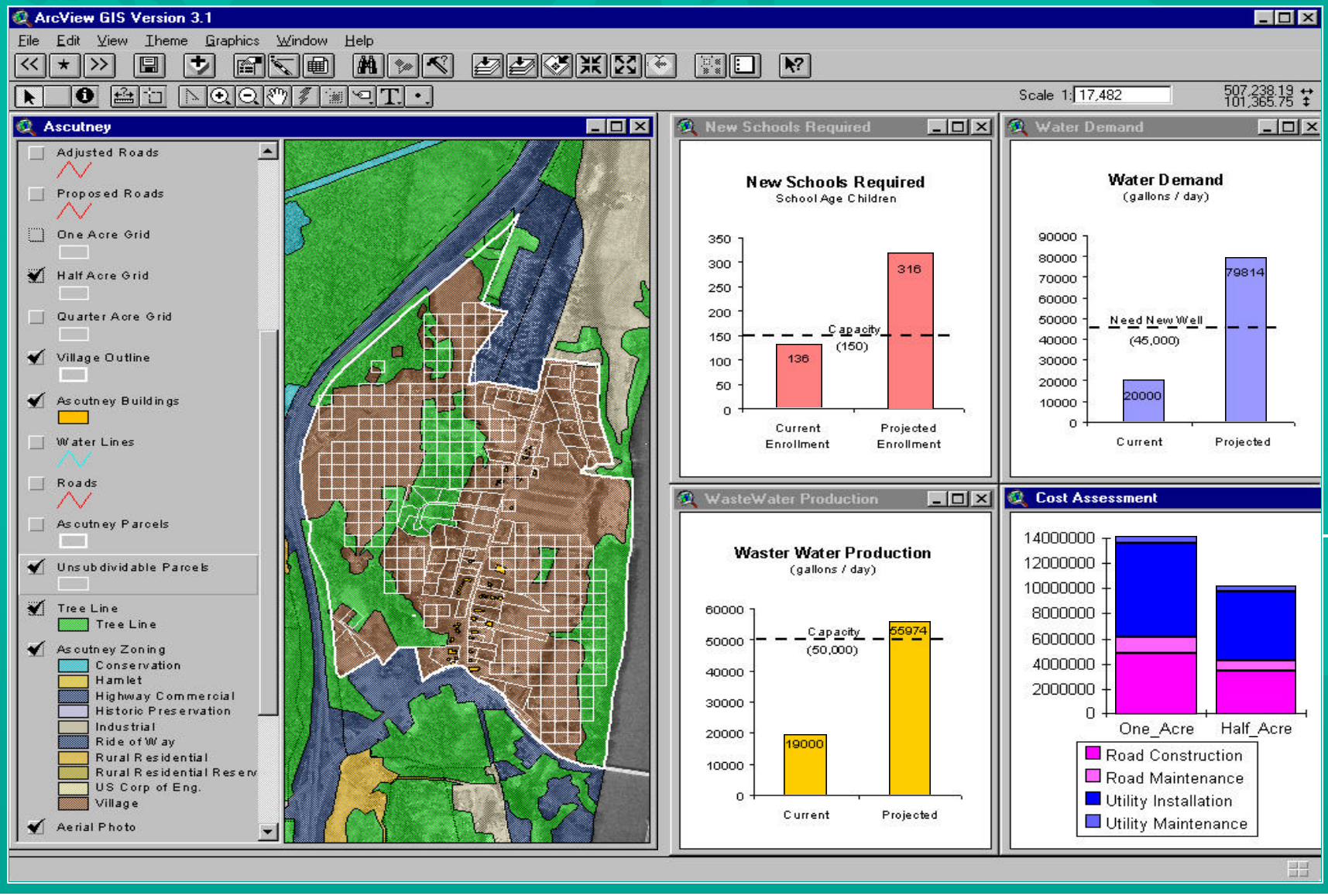
Orton Family Foundation

CommunityViz - Split Screen Interface



Orton Family Foundation

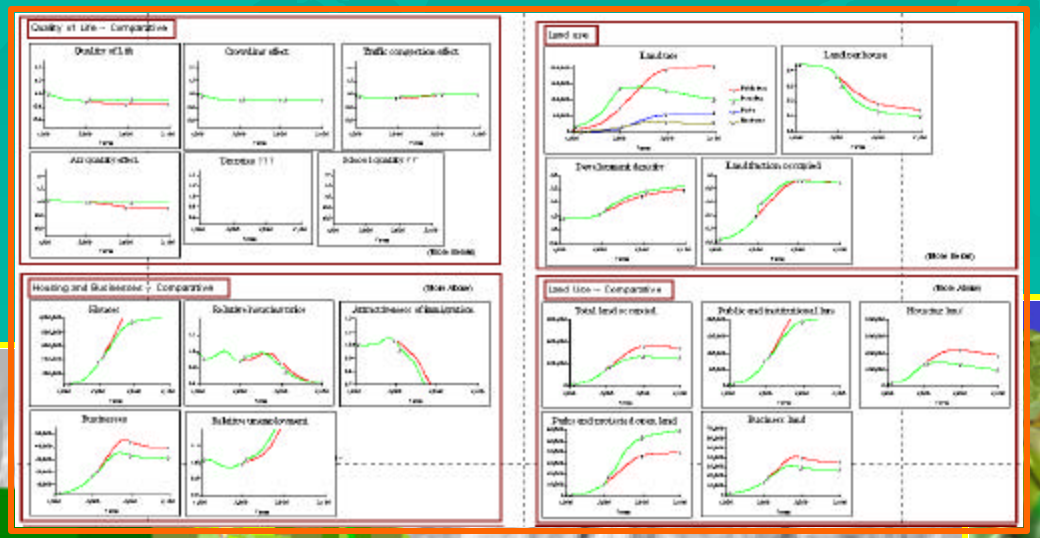
CommunityViz - Impact Analysis

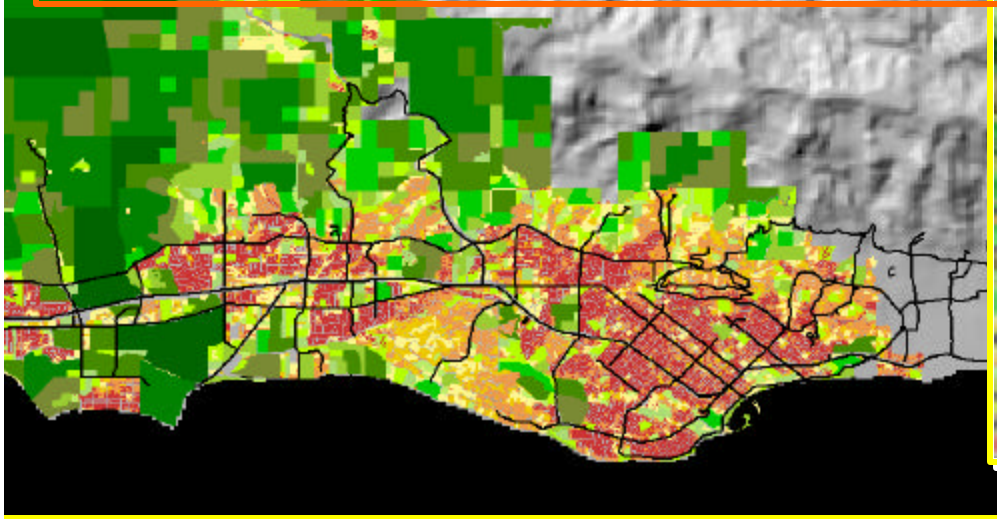


Savings

U-Grow

Data from scenario runs can be output in several ways, from graphs to 2D GIS to 3D interactive "fly-thru"





A glimpse into the future…

Continuum/Houston, TX

Decision Support Tools

- Information Resources
- Visualization Tools
- Impact Analysis
- GIS Modeling
- Community Process Tools

Co-Vision/Option Technologies
DC's Citizen Summit

PLACE^{3}S

PLANNING FOR COMMUNITY ENERGY, ENVIRONMENTAL & ECONOMIC SUSTAINABILITY

PLACE^{3}S Planning Process

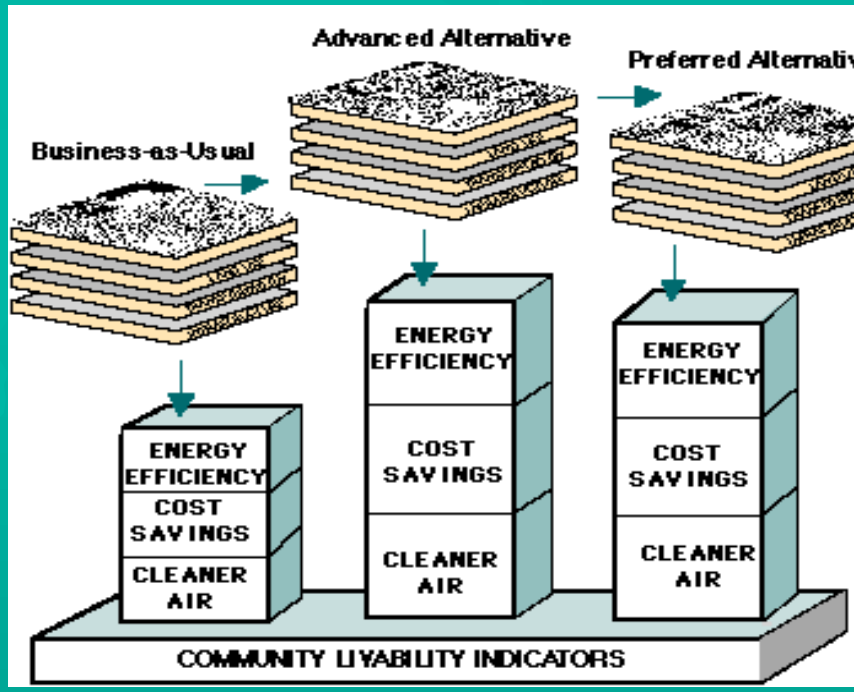
Step 1: Start Up and Identify Existing Conditions

Step 2: Establish Business-as-Usual Alternative

Step 3: Analyze Alternative Futures

Step 4: Create Preferred Alternative

Step 5: Adopt, Implement, Monitor, and Revise



PLACE^{3}S San Diego Regional Study Results

- $1.5 billion retained regionally/15 years
- 1/2 million tons air emissions eliminated
- 5,000 energy-related jobs created
- Supports and integrates RGMS elements
- Long-term implementation and marketing values
- Regional Energy Resource Office

Regional Resource Centers

- Regional Resource Centers can improve both the process and outcomes of decision-making...

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The Challenge

- Federal government nation's largest energy consumer (2%)
- DoD largest Federal consumer (75%)
- Military energy use significant source of greenhouse gas emissions (19.5 MMTCE in 1996)
- Military energy consumption diverse

DoD Opportunities

- 3 million personnel
- 36 million acres of land
- 250 major installations
- 40,000 additional properties
- 1.5% of federal energy consumption
- 550 public utility systems

U.S. Army Opportunities

- 78 major bases in U.S.
- 130,000 buildings in U.S.
- 900 million square feet worldwide
- $7.9 billion in energy costs worldwide

  - Sources: 1999 GSA Federal Inventory, U.S. Army Energy Office

Benefits for Army

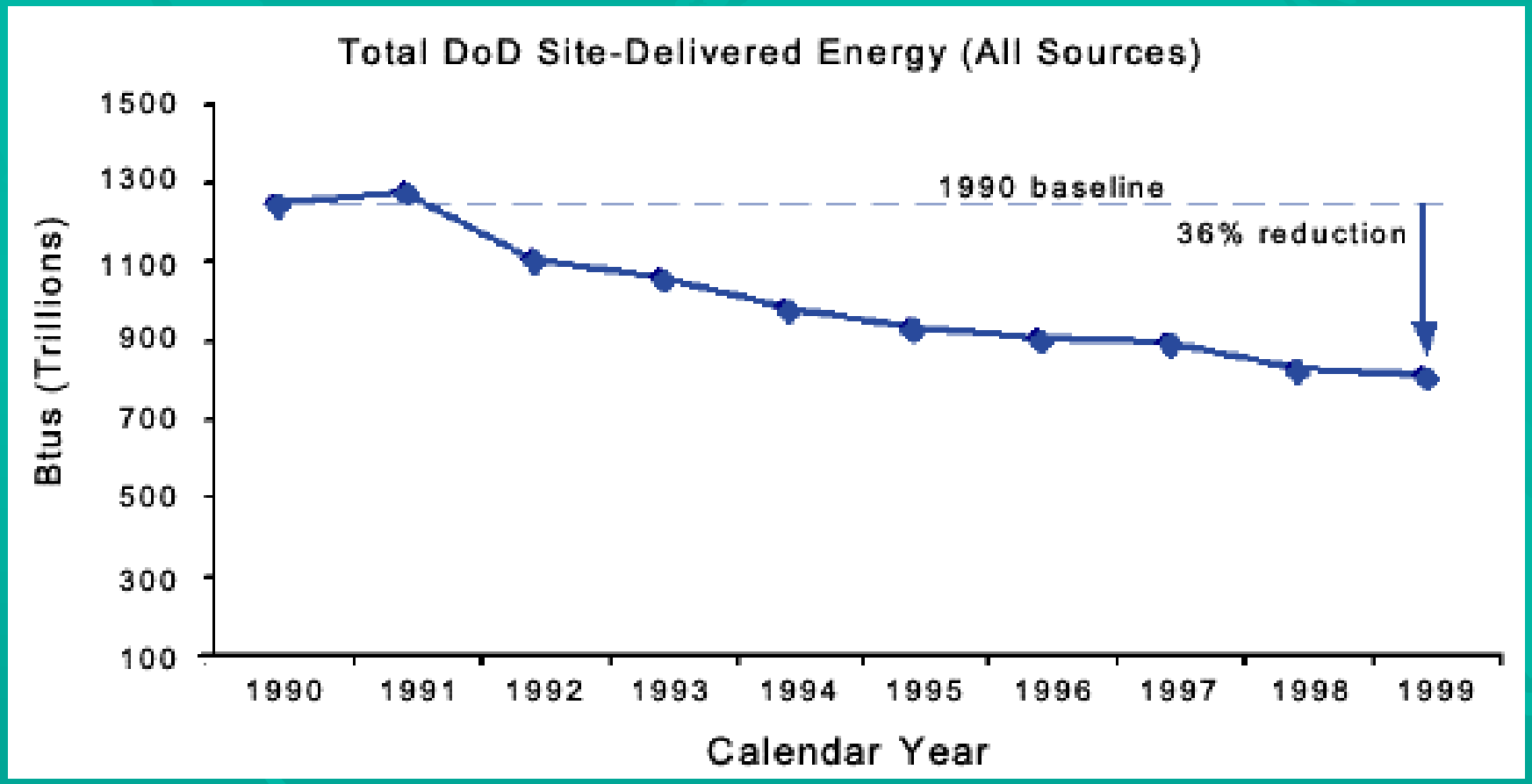
- Lower energy & waste-handling costs
- Savings free funds for more critical needs
- Sustainable technologies help Army comply with Executive Order 13123
- Sustainable energy technologies reduce foreign-oil dependence & greenhouse gas emissions, enhancing national security

DoD's Performance So Far

- Reduced hazardous waste by 50%
- Reduced toxic chemical releases by 65%
- Reduced pesticide use by 32%
- Completed cleanup on 60% of active & inactive sites
- Increased solid waste recycling to 50%
- Closed 700+ firing ranges to prevent lead contamination

Source: Deputy Undersecretary Sherri Goodman, Detroit News.
Numbers represent 1993 to present.

DoD's Performance So Far



Retrofitting Sustainability

- Walking/biking trails
- Energy efficiency improvements to buildings
- Mixed-use development as bases grow
- Landscaping to cut energy consumption
- PV in remote locales
- Traffic-calming devices to enhance pedestrian safety
- Retrofitted solar electric & water-heating systems
- Green power purchase
- Recycling programs

Greening the Pentagon

- 14-year, $500 million project
- Performance based: fee award to 10% of contract if design-builder meets energy & environmental goals
- No prescribed specs: A/E/C develops performance goals
- Onus on contractor to research technology and practices
- Contract to be let next Spring

State of the Pentagon

- 7,748 antiquated windows with 30% energy loss
- All building systems need replacement: utility distribution system, HVAC
- Leasing boiler/chiller plants at $200k/month
- Poor air flow
- Millions of pounds of lead and asbestos contamination

THE SOLUTION:

A COMPLETE RENOVATION
"Ceiling to Slab"

- *Replace all building systems*
- *Remove all hazardous materials*
- *Improve energy efficiency*
- *Bring building up to code compliance*
- *Improve vertical mobility, comply with ADA*
- *Enhance security*
- *Improve pedestrian and vehicular traffic flow*
- *Preserve/Restore Historical Features*

Candidate Projects

- Renewable carpet (save $14m over 30 years)
- HVAC energy management system (EMCS)
- Energy-efficient HVAC
- Re-manufactured furniture (1/2 price)
- Energy production:
  - 10kw solar dish system
  - 70kw of PV power
  - 3 wind turbines on Mount Storm
- 5 rooftop solar water heating units
- energy efficient blast windows (tinted low-E)

Renovation Goals

- 35% energy reduction in year 2010
- Energy Use Index down from 135 kilowatts/btu/square foot today to 100.6 in 2010
- No hazardous materials or waste left in the renovated building

15-kilowatt photovoltaic system

"Greening of the Pentagon"

Initiatives

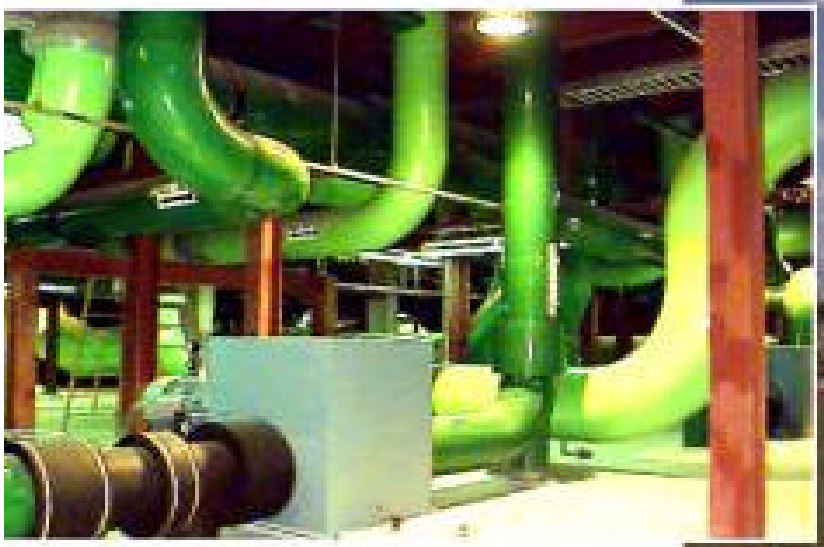
- *Original Heating & Refrigeration Plant demolished*
  - *Coal-fired until mid-1980s*
  - *Completely obsolete*
  - *Boiler, chillers leased at total cost of $200K/month*

"Greening of the Pentagon"

Initiatives

- *State-of-the-art Heating & Refrigeration Plant (cont'd)*

- *30 % more efficient*
- *Pentagon architectural features replicated*

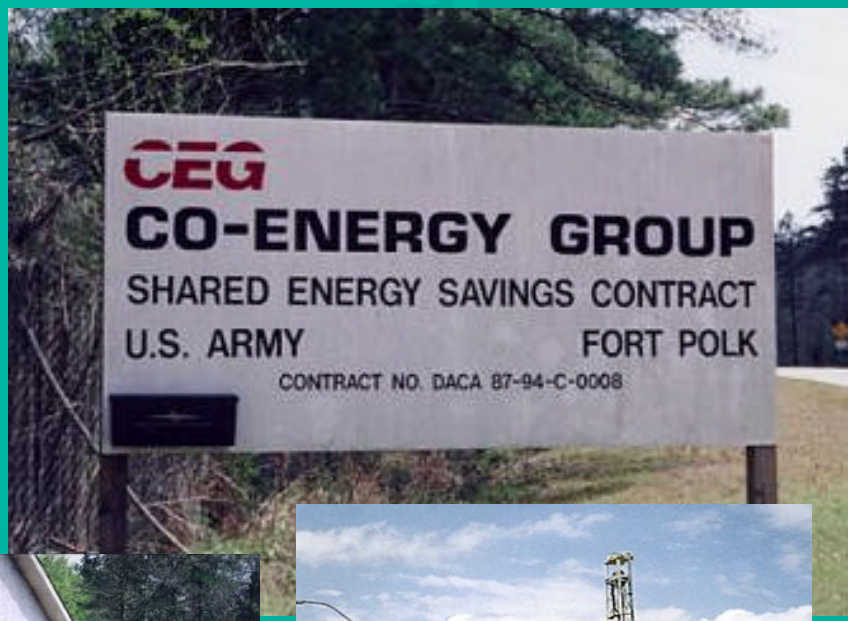


Washington D.C. District Project

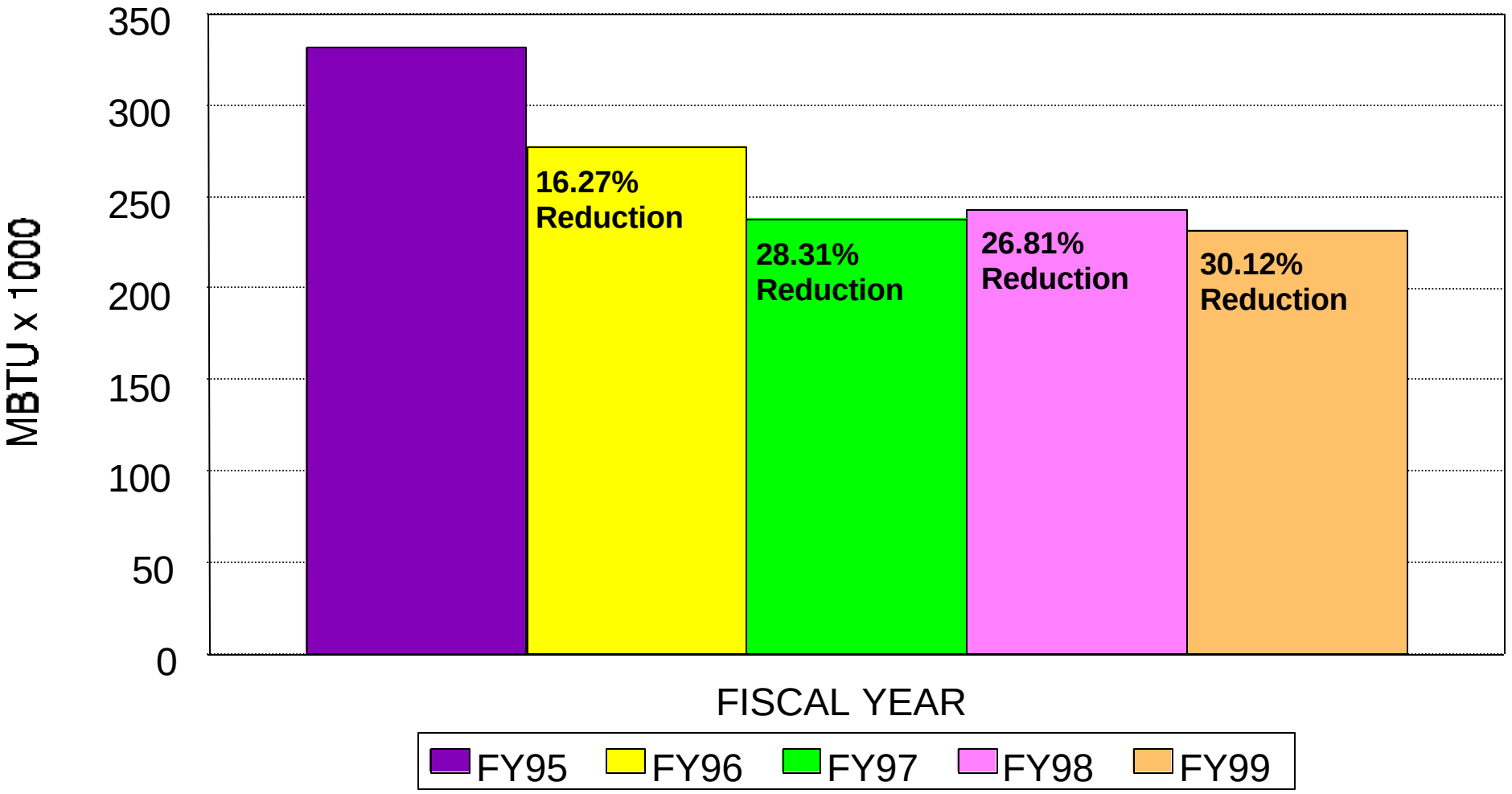
- Five Army Forts
  - Fort McNair
  - Fort Myer
  - Fort A.P. Hill
  - Fort Meade
  - Fort Belvoir
- 837 buildings
  - 143,000 light fixtures
  - 626 Cooling systems
  - 5 Central heat plants
- $67 million investment
- $220 million in savings over 18 years

Ft. Polk: Ground Source Heat Pumps

- **Capacity = 6,593 tons**
- **4,003 living units**
- **1,290 buildings**
- **One GHP per living unit**



Family Housing Energy Consumption
Ft. Polk - FY 95-99



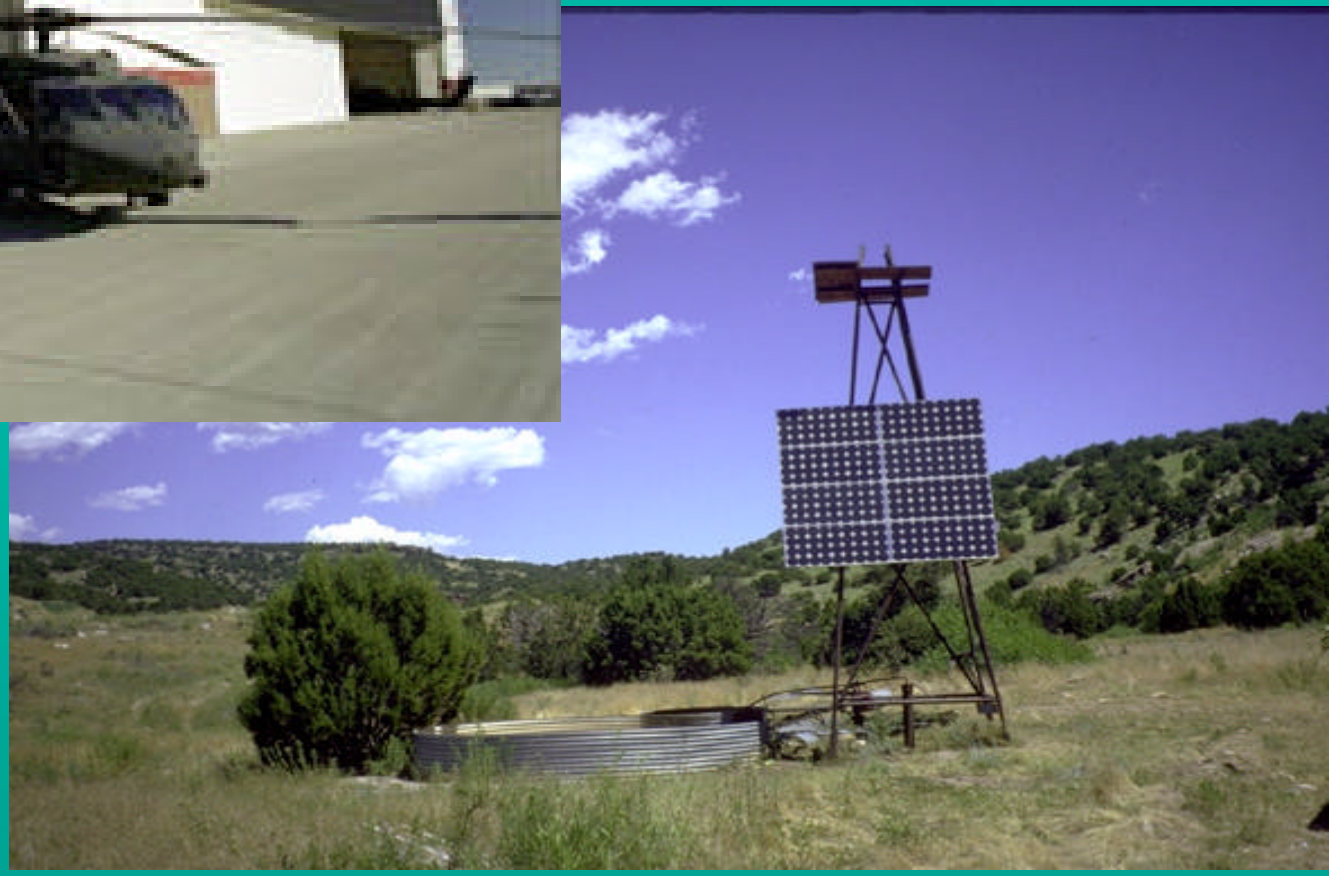
Ft. Carson: Comprehensive Energy Program

- More than 12 million square feet under roof
- $12 million annually in fuels and utilities
- Command level support with energy objectives set by Commanding General
- Program integrates energy management, pollution prevention, water conservation, sustainability of training lands
- P2 Division oversees most of program

Ft. Carson: Energy Projects

- Utility control systems
- High-efficiency boilers
- T8 lighting
- High-efficiency motors
- Intelligent HVAC
- Photovoltaics
- Family housing revitalization: weatherization, doors/windows, furnace, toilets, thermostats

Solar at Ft. Carson



DOE Resources

- Federal Energy Management Program
  - Design assistance, energy audits, software, training, Energy Saving Performance Contracts
  - “Greening Federal Facilities” Resource Guide & Toolkit at www.eren.doe.gov/femp/techassist/greening.html
- Associated DOE Programs:
  - Buildings, power systems, transportation, industry
  - www.eren.doe.gov
- Sustainable development
  - Center of Excellence for Sustainable Development
  - www.sustainable.doe.gov

Conclusions

- Sustainability an emerging standard for community development
- Same technologies & practices can be applied in Army development
- Army can achieve many of same benefits as local governments
- Tools & help are available